VOLUME VIII APRIL-JUNE, 1933 No. 2

LIBRARY
FISH & WILDLIFE SERVICE
PACIFIC OCEANIC FISHERY
INVESTIGATIONS

JOURNAL

OF THE

Pan-Pacific Research Institution

A Periodical Record of Investigations Bearing on Problems of Food Production, Distribution, Conservation and Consumption, as well as on Public Health, and Race and Population Problems as Related to the Countries Bordering on the Pacific.

INDEX

Oysters in Hawaii, J. H. Connell . . . 2
Pan-Pacific Union -- Mikimoto 3
Prized Pearls of Industry, R. Ellis . . 5
Oysters in California, H.C.McMillan . . 6
and Paul Bonnot
Oysters at Willapa Harbor, G. Ablan . . 8

Zoogeography 9

"Uncle Sam's Reindeer" Help to Alaska . 11

Poi Making Today 12

Industrial Use of Limu, L.S.Nakashima . 14

Hawaii's Climate Ideal for Perfume. . . 15
Plants, T. C. Zschokke

AT PRESENT PUBLISHED QUARTERLY AT HONOLULU, HAWAII
BY THE
PAN-PACIFIC UNION

More frequent publication as acceptable material is contributed.

OYSTER AND CRAB CULTURE IN HAWAII

By
John Hardin Connell

It is quite possible that sometime in the future Honoluluans will be feasting upon as delicious home grown oysters as ever came out of the blue waters of Chesapeake Bay. Several years ago small importations of the edible oyster were made from Chesapeake Bay and the Barrier Reef in Australia and placed in Kaneohe Bay, Oahu. These plantings were made under the supervision of the Fish and Game Commission of the Territorial Department of Agriculture, and the results are being carefully watched by H. L. Kelly, the director of this commission.

Two years ago the waters of Kaneohe Bay were analyzed by Dr. Paul S. Galtsoff and found to be well suited, as to mineral content, for the successful cultivation of the edible oyster. Not only do the waters of this bay have the necessary mineral content, but they contain an abundance of diatoms and plankton, the microscopic animal and plant life, upon which the oysters feed.

Plantings, because of the lack of funds, have not been as extensive as they should be, in order to obtain commercial yields in a comparatively short time. However, from the small plantings already made, it has been proven that the oysters introduced have thrived and grown and to a certain extent have been producing spats, a spat being a young oyster. To just what extent reproduction has taken place, it is impossible to estimate. For the first four or five days of its youthful career, the spat, or young oyster, floats in the water and may thus be carried by the currents a long distance beyond the spawning ground. All oysters may be glum, but the little spat has at least oyster, if not horse, sense, for, at the end of the five-day period, when the shell begins to form, it looks around for a permanent homestead and, sinking to the bottom, it attaches itself to a rock or any other suitable object it may find. Mr. Kelly states that these young oysters have been found at least four miles from the planting ground, showing how difficult it is to check up on reproduction. Then, no doubt, many of the spats are devoured by fish before attaching themselves, another factor making it impossible to estimate reproduction. But it is encouraging to know that the edible oyster not only will thrive but will propagate itself in island waters.

We have been speaking of the edible oyster, but its first cousin, the pearl oyster, should be considered for a place in the commercial sun of the islands. This oyster is indigenous and should be cultivated for the mother-of-pearl which is used in the manufacture of buttons. Sometimes valuable pearls are also found in these oysters.

As an experiment, June 10, 1932, twenty-four mother-of-pearl oysters were taken from Honolulu Harbor and planted under Mokapu Station pier. Measurements were taken June 17, 1932, and again on December 17, of the same year, when it was found that the smaller sizes had made a growth of 79 per cent and the larger sizes a growth of 13 per cent. As this oyster is indigenous to island waters, the experiment would indicate that there is a profitable future ahead for the commercial development of the oyster shell industry.

In speaking of shell fish, it will, no doubt, be a joyful surprise to all of those whose gastronomic pulse increases its beat at the mere mention of crab meat to learn that within the coming year perhaps they will be able to obtain island grown Samoan crabs in the markets of Honolulu.

About six years ago this crab was imported from Samoa. So quickly has it adapted itself to local conditions that, after the next spawning

there may be a short season on this delicious crab. Already it is firmly established in the waters around Oahu and Kauai.

This crab attains a weight of four pounds or more, the meat being of fine texture and excellent flavor. It is reported that one of these crabs was seen in island waters that weighed approximately nine pounds. Just think for a moment of the salads contained in this one crab! And, now, if you are equal to it, think of these crabs tipping the scales at eighteen pounds, as they have been known to do. Apparently, the Samoan crab has taken to its Hawaiian environment with enthusiasm and has found the food supply just as abundant and just as nutritious as in its native island. (Honolulu "Advertiser", March 5, 1933)

PAN-PACIFIC UNION ENTERTAINS MIKIMOTO REPRESENTATIVE

Last year Alexander Hume Ford, Director of the Pan-Pacific Union, interested Kokichi Mikimoto, "pearl king of Japan", in visiting Hawaii for the purpose of a survey to determine the possibilities of oyster pearl culture in the Islands. Mr. Mikimoto promised to spend two weeks in Hawaii in May, 1933, en route to the Chicago World's Fair, and presented Mr. Ford with a motion picture film, of pearl oyster culture in Japan. Later on his son-in-law, Reikichi Yokohama, was entertained at the Pan-Pacific Club on his way to Los Angeles to establish a branch store of the Mikimoto firm. Former Governor Wallace R. Farrington presided, and a group of interested scientists gathered to see the sample pearl oysters brought by Mr. Yokohama. The Board of Agriculture and Forestry kindly offered to cooperate in the proposed survey.

At the Pan-Pacific Science meeting of April 1931, Dr. Paul Galtsoff, U. S. Government Fisheries Service, Washington, D. C., was the guest speaker and gave a talk on his survey of Hermes Reef, from which he had just returned. He had previously met Mr. Mikimoto in Florida, seeking a place near Miami where a pearl station might be established. And Dr. Galtsoff then began to look to Hawaii as the location of a possible pearling station. He wrote to the Pan-Pacific Research Institution, and it was at once arranged that the chairman of the Pan-Pacific junior scientists, Northrup Castle, would accompany Dr. Galtsoff as a guide to the pearl lagoons of Pearl and Hermes Reef (1,000 miles northwest of Hawaii) with which Mr. Castle was familiar. On his return, in an address to the members of the Institution, Dr. Galtsoff announced that pearl oysters could be grown in Hawaiian waters.

A further account of the pearl oyster industry is given in "The Japanese American", New York City: Since ancient times the pearl has been treasured as one of the rarest of jewels. Because of its rarity, and the difficulty in securing them only the wealthy of the earth could satisfy that love of the beautiful so characteristic of all women. In the last half century science has yielded up the secret of pearl culture, and today women's most chaste and beautiful adornment is within the reach of all.

Forty years ago Kochichi Mikimoto sat on a black rock on the shore of his native Gokasho Bay in the Miye Province, 100 miles south of Nogoya, on the Pacific coast. He dipped his foot in the warm, dark waters of the Japan current that washes the coasts in that region, and dreamed of pearls. There was nothing new about that for since generations on end men have been diving in that locality for wild pearls. The results of their labors though were meager, and the occupation fraught with great hazards. Mr. Mikimoto, then a very young man, saw that nature could be assisted by science in growing pearls, and a degree of certainty assured as to the quantity secured.

The dream unfolded and today his pearl industry plants 3,000,000 pearl oysters annually, and the annual value of his production averages about $2,000,000. About 1,000 persons are employed in his enterprise,

including experts in all lines of business. Within the Empire of Japan alone he owns and operates eight large culture stations; and in the Isle of Palao in the Caroline Island he controls one station. Altogether the area of his nine stations covers 41,000 acres.

Pearls are nature's way of protecting the little oyster against some irritant that finds its way inside its shell during its ten years of living. In the case of wild Oriental pearls, the irritant enters the oyster accidentally. In the "Mikimoto Pearls" it is placed there intentionally by scientific methods.

The Mikimoto pearls are identical in every respect with those produced accidentally by nature and have the same spherical shape and high luster as the finest specimens of Nature's Orientals.

When the pearl oysters are three years old the healthiest and strongest are chosen and a seed pearl or tiny spherical piece of mother-of-pearl is inserted inside the shell. This operation is done by experts between the months of May and November. The oyster immediately begins the secretion of nacre to shut itself off from the irritant.

It takes at least seven years of such secretion before "Mikimoto" pearls have developed. At least 20 per cent of the oysters are lost by mortality in this interim. Of the number cropped, 20 per cent do not bear pearls. Of the 60 per cent that are fruitful, Mr. Mikimoto, because of his high ideals in the development of his pearls, sees fit to market only five per cent. Only those with thick skins and fine quality go out into the world. He controls 80 per cent of the whole Japanese pearl industry.

Many of the world's most prominent biological scientists have made exhaustive tests of the "Mikimoto Pearls" and have pronounced them to be real, genuine pearls in every sense of the word. Among the eminent scientists who have made these tests are Dr. David Jordon, of Stanford University, California; Dr. Charles A. Kofoid, of the University of California; Prof. Boutan, Prof. Jubin, and Prof. Dolfus of France; Dr. Eppler of Germany, and many Japanese biologists.

Wild Oriental pearls have many enemies if they live a natural life. Among them is the red current, a microscopic insect moving in such thick masses that it suffocates anything it surrounds. Seaweeds and the octopus, the star fish and hard-mouthed fish are other enemies. From its mouth the octopus secretes a poison that melts the oyster shell that it may devour it.

Each shade of pearl has its special market among the women of the world. In Italy and Spain the women prefer darker tinted pearls; in France, England and America they like the rosy-tinted pearls. Japanese women like silvery ones with a slightly pink sheen.

The climate was in Mr. Mikimoto's favor, said Mr. Juso Seo, manager of the New York branch of K. Mikimoto. Even in mid-winter the temperature of the water must not be below 10 degrees Fahrenheit. The food conditions for oysters on the southeast side of the main island of Japan are excellent. This locality too has been known since ancient times for its beautiful pearls.

Mr. Seo, who came to this country first in 1927, was transferred from K. Mikimoto's London branch, when the business was enlarged. Almost immediately after graduating from the Tokyo Commercial College in 1915, Mr. Seo was introduced to K. Mikimoto, who at once took him into his firm. Among the many organizations to which Mr. Seo belongs is the Masonic Lodge, in which he is a Shriner of the Mecca Temple. He belongs to that select group of wealthy Japanese in Port Chester, N. Y., where he lives with his wife and a small daughter of six years.

THE PRIZED PEARLS OF INDUSTRY

By
Reggie Ellis,
On Staff, "The Du Pont Magazine"

Styles, designs and colors of today's products are continually changing to meet the public demand. When color swept into the bathroom, toilet seats, towels, hampers, towel bars, toothbrush handles and all other bathroom accessories instantly underwent a rejuvenation to make a more harmonious effect. And this wave of color was by no means limited to the sanitary field; fountain pens and toilet-ware, table knives and buttons have all been given that pearly effect which makes products so much more salable than heretofore. After all, salability is the main thing shrewd manufacturers are constantly on the lookout for; that something to make products more attractive to buyers.

A material has been found that gives to manufactured products a pearly luster. The only substance that has ever met this need satisfactorily is the silvery substance deposited in the skin of many species of fish. When scrubbed off the scales, freed from foreign matter and suspended in water or other suitable liquid, it is ready for use. And when incorporated properly in a pyroxylin plastic material, it gives the beautiful lustrous mother-of-pearl effect that is now rapidly coming into universal use in the manufacture of toiletware, toilet seats, fountain pens and a great variety of other products.

Probably few people know how this effect is obtained. By way of explanation, the material referred to is called pearl essence. In literature many vague references are made to its origin. Many books on pearls in sections on imitations, mention the use of "ground-up fish scales." As a matter of fact, fish scales themselves do not enter directly into the manufacture of pearl essence. The lustrous ingredient is obtained from guanin crystals, which are not found in the scales but are deposited in the epidermis of the fish, parts of which adhere to the scales when they are removed. This epidermis is the source of the shiny crystals, and their removal is the first operation in the manufacture of the essence. By far, the greater amount of the lustrous substance remains on the fish and is never removed.

The scales are usually collected from the fisheries and washed in soap and water, while still fresh. The next step is to scrub off the lustrous material from them. This is done in a large agitator with a revolving member, like the old-fashioned ice-cream freezer. The crystals are disengaged from the scales and, being lighter than water, float to the top, while the scales and dirt settle on the bottom.

Now comes the task of separating the lustrous substance from the wash water. For this purpose large revolving drum centrifugals are used, in which the liquid is thrown against the inside surface of the drum. The material thus collected is scraped out and put into a bath in which various chemicals are used as a degreasing agent. This removes the fatty matter, and after twenty-four hours the sediment is centrifuged again to remove the water and chemicals of the degreasing bath. To the paste remaining, ordinary clear lacquer is added and because these crystals have a greater affinity for an organic solvent than for water, they go into the solvent, leaving the dirt, chemicals, and water behind. The pearl essence thus obtained, when mixed carefully under close chemical control with other ingredients used in the manufacture of Pyralin, produces the beautiful pearly effect noticed on various kinds of articles today.

As never before, we are living in an age of color. Everywhere manufacturers are confronted with the problem of appealing to the public taste and of producing the type of merchandise that will of itself create a desire for its possession. Moreover, the success or salability

of an ever-increasing number of products depends almost entirely on the direct appeal made to the esthetic sense of consumers.

Forward-looking manufacturers are saying, "Give us a material that lends itself to modern merchandising methods." Pearl Pyralin is being recognized more and more as this material. The adoption of mother-of-pearl finish is the natural outgrowth of the desire for smarter looking and more salable merchandise.

The use of pearl essence, which was formerly confined to the manufacture of imitation pearls and mother-of-pearl effects, has now entered practically every field that its lacquer vehicle embellishes. It is now recognized that the crystal of pearl essence, used in the manufacture of Pearl Pyralin, gives depth of color and brilliancy of color effects. A satin-like luster is obtained that formerly could only be achieved by individual artistry; in addition, new creations are obtained that were once strictly confined to Nature's own handiwork. Today, the most fastidious individuals can secure many of their personal articles and other necessities in creamy Pearl Pyralin finishes. And more and more people are buying them.

OYSTER CULTURE IN CALIFORNIA

By
H. C. McMillin and Paul Bonnot
On Staff, "California Fish and Game"

Oyster culture, which has been neglected in California for a long time, is being revived by several old-time oyster men. The introduction and propagation of exotic species of oysters in California waters was advocated a good many years ago. Dr. Townsend, in his report on Pacific coast shellfish, in the report of the U. S. Commissioner of Fisheries for 1889-91, says:

"With evidence at hand of the propagation of our own oyster (O. virginica) in California, the introduction of foreign species seems superfluous; but Professor George Davidson and Mr. H. D. Dunn, of San Francisco, both of whom have resided in Japan, have frequently spoken to me of the large oyster of Japan in connection with the subject of oyster growing in California. Prof. Davidson sends the following note on this subject. 'The oyster I knew in Japan was found in the vicinity of Nagasaki. . . . The oyster is there very large, full, and well flavored. I obtained some shells from Japan that were fully twelve inches long.' The introduction of oysters from Japan would probably not be difficult as a great many species of shell fish from that region are identical with California species."

The eastern oyster (O. virginica) which Dr. Townsend mentions, was the basis of extensive activity in San Francisco and Tomales bays for a long time. At first seed oysters were brought out, planted on the mud flats and allowed to grow to marketable size. The eastern oyster was never successfully spawned in California, as the methods of culture were rather haphazard. Some years ago the growing of oysters from imported seed received a check. It was found that, instead of maturing into fat, healthy specimens, the oysters grew slowly and were thin and watery, and unfit for use. The reasons for this are still imperfectly known. The practice today is to ship full-grown oysters and merely hold them on the beds until such time as they can be marketed. The oyster supply of late years has consisted of these eastern oysters in the shell, shucked easterns on ice, native oysters (O. lurida) called "Olympias" shipped to California from the State of Washington, and a few local natives.

There are several reasons why it would be profitable for California to grow her own oysters. It is expensive to ship mature eastern and

Japanese oysters for immediate consumption. Due to lack of space, the supply of Olympias is limited.California oyster growers have therefore started oyster culture in the state on a scientific basis. To date the work has been mostly of an experimental nature, but the results so far have been more than justified.

In 1914 Japanese seed oysters were first shipped to British Columbia. The shipment consisted of twenty boxes. In 1916,on the strength of the success in British Columbia, commercial planting of oysters was started in the State of Washington at Samish Bay. During the World War there were no importations of seed. In 1919 the business was resumed. It has spread along the coast of Washington and Oregon and is now being started in California. The results so far indicate that a valuable industry is being established. One thousand boxes of seed oysters per year were planted in the State of Washington between 1920 and 1926.As the demand for seed increased, the Japanese seed producers began to extend their operations.

In 1925, the U. S. Bureau of Fisheries made a preliminary survey of the industry. One of the important problems which were brought to the attention of the importers and growers was the danger of imported pests. It was found that the oyster drills and other undesirable forms not only withstood the trip but were growing and reproducing in their environment, while the oyster failed to reproduce and the stock had to be continually replenished with new shipments of seed. Clean seed was an important factor and the Japanese government assisted the seed producers in the development of the "hanging" method of spat catching.

This system consists of long lines of posts set into the mud, with several strands of wire running from post to post, from which other wires hang down. On these hanging wires are threaded oyster, scallop and abalone shells, and on these the young oysters set. By this means, the surface available for oyster setting is greatly increased and, since the shells never touched the bottom, the oyster drill is practically eliminated, because it is a bottom form.

As soon as the set was finished,the shells were taken from the wires, packed in boxes,and shipped to Washington on the decks of passenger or fast freight steamers. From the idea of hanging the spat collectors has developed a float to take the place of the fences. The floats can be used in deep water and after the spawning season may be used to grow oysters for the local markets, using a portion of the seed which they have collected. After growing the oysters by this method for several seasons, it was found that when shells were strung on wires the spat set on both sides, and as the young oysters grew it was difficult to keep the shells far enough apart on the wires to allow for growth; and when the shells were bedded on mud flats a certain percentage of the young set were smothered. It was necessary, therefore, to develop a spat collector of small diameter from which the oysters could grow outward in all directions. This led to the use of a half inch tarred rope which is wound about frames, generally in lengths of 150 feet,and suspended from floats. As the spat grow outward from the center, there is plenty of room for all of them; and the Japanese growers estimate that they can mature 100 marketable oysters to one foot of rope. After obtaining the set,the ropes are looped or cut into suitable lengths, depending on the depth of the water.If the float is anchored where there is 8 feet of water at low tide,the ropes are 8 feet long. For shipment to the United States, the ropes are slipped from the frames and packed flat in wooden boxes, four bunches or 600 feet to the box, with layers of rice straw between to reduce chafing. The floats used in Japan are made of bamboo poles, floated on barrels. Recently a shipment of 243 boxes of seed oysters on rope was put out in Elkhorn Slough, near Moss Landing, California.

Similar floats were constructed to determine the feasibility of us-

ing this method.

These floats are built by placing pine 2 x 4s on edge in the manner of the floor joists of a house.They are suitably braced and are floated by six tarred steel drums. Each float is 32 feet wide (two 2" x 4" x 16', spliced together) and 18 feet long (12 joists 18" apart). The floats are strung together in batteries to suit local conditions. They are tied together by two ¼" steel cables which run from the anchors at each end, over the floats for the full length of the battery. A board catwalk acts as a spreader and a convenient and easy way to get from one float to another, and two cross wires between each float prevent twisting.Constant position is maintained by the use of flat cement anchors at each end of the battery and along both sides. Some 40 floats are now in operation at Elkhorn Slough under the supervision of Kuroki Miyagi, who came from Japan to put this method of oyster culture into operation in this country.

This method of oyster farming has several advantages. A maximum set of spat is possible to begin with, and after obtaining the set, the oysters can be left as they are and can develop to maturity without crowding. The growing oysters can be easily shifted from one place to another as local conditions change. The building up of a hard bottom, which was a prime requisite under the old methods of culture, is now considered unnecessary. It is unnecessary to confine oyster culture to any limited zone and the three dimensions of space in the water may be utilized.The effect of pests is also reduced.The Japanese oyster drill is a bottom dwelling form and has no free swimming larval stages;therefore, it does not come in contact with the spat collectors hung from floats,and seed obtained in this manner can be imported with a minimum of danger.

OYSTERS AT WILLAPA HARBOR

By
Guillermo Ablan
On Staff, "The Philippine Review", Seattle

The life of the oyster is one of the most amazing things in the world, and because of this fact, it is a very fascinating study. The growth of the oyster undergoes several stages, and the queer thing about the adult stage is that it loses its power of locomotion.The old oyster stays put in any place it settles unless removed.

Some interesting facts about the Japanese oysters (Ostrea gigas), native of Japan and now profitably cultivated on the Pacific Coast of the United States,will capture the imagination of anyone who will take the trouble of visiting the oyster beds at Willapa Harbor, Washington. Acres of oyster clusters are cultivated in this harbor, and they present a good opportunity to those who are interested in examining the life of the oyster for commercial purposes.The oyster clusters, rising like so many heads of cabbages packed so close together that it is hard work to walk through them,are interesting by themselves, but more interesting is how they grow.

The oysters at Willapa Harbor are cultivated and show remarkably rapid growth due to the favorable temperature of the sea water and the abundance of plankton organisms necessary for their food. They begin spawning after they are more than a year old in July at a temperature of about 68 degrees F. Breeding oysters when opened are milky because of the milky looking fluid which they exude at that time.A drop of the milk of the female as magnified under the microscope is composed of millions of minute eggs usually spherical,oval or pear-shaped, that of a male of an incalculable number of extremely small spermatozoa. Estimates of American investigators show that a female oyster contains from 16,000,000 to 107,000,000 eggs, depending upon the size and the

species.

At spawning time the eggs of the female and milt or sperm of the male are cast out into the water. Out of the million of eggs which are fertilized in the natural state, very few develop due to physical or biological causes. The unfertilized eggs die and disintegrate.

Where the sperm drifts or swims by violent flapping of its tail to penetrate the non-mobile egg, the act of fertilization begins the life cycle of the oyster. The sperm infuses new life and vigor. This is the only means of carrying over the hereditary qualities of the male parent to the offspring. After fertilization has taken place, the impregnated egg divides again and again, forming a cluster of many tiny cells. In the course of a few hours of development, cilia appear on the developing young oyster. This is known as the trochophore stage. With the cilia it is able to swim while being drifted about by ocean currents and tidal winds. This embryo develops a pair of tiny shells. These shells grow larger and heavier and finally the young spat drops to the bottom to attach itself to any clean surface of stones, rocks, shells, tiles, wood or bamboo stakes. After it has attached or fixed itself to any of the cultch it entirely loses the power of locomotion.

The oyster, because of its fixed position is unable to go to search for its food. It is also defenseless from its enemies. However, nature has equipped it with the power of obtaining food from the water in close proximity by the closing and opening of its shell.

The facts mentioned above point out certain problems which would confront an oyster culturist or anyone who intends to raise oysters as a source of food in the Philippines.

Through artificial propagation of our Philippine oysters, we can raise more for food and utilize the suitable areas for their culture. Lewis Radcliff, deputy U. S. Commissioner of Fisheries, stated that the application of the same amount of labor and degree of attention to water areas as to land areas, water areas can be made to produce regular returns from the standpoint of productivity, the five species of oysters thriving in our Philippine waters, as mentioned by Hanley and Artemus I. Day, could be tried for artificial propatation. The species mentioned are Ostrea mytiloides, Ostrea echinata, Ostrea orientalis, Ostrea pyxidata, and Ostrea palmipes.

Besides these species, we have two other species of mother-of-pearl oysters, namely Margaritifera maxima, the gold edge and silver lip, and Margaritifera margaritifera, the black lip type. The pearl oyster beds of the Philippines extend from Sibutu Pass to Basilan Straits, and roughly cover an area of about 15,000 square miles. M. Florencio Tavalera, of the Philippine Bureau of Science, in his survey of the Pearl Fisheries of Sulu, mentioned nine pearl beds in this region: Basilan, Pilas, Samales, Pangutarang, Jolo, Laparan, Tapul, Tawitawi and Sibutu. These oyster beds could be made more productive by applying the method of Kochichi Mikimoto, the pearl king of Japan, who spent 23 years on pearl experiments.

ZOOGEOGRAPHY

The following reference appears in an essay on the Zoogeography of the Pacific Islands, by Karl Patterson Schmidt, leader of the Scientific Section of the Crane Pacific Expedition:

The Fiji Islands present the first considerable landmass encountered in crossing the Pacific to the westward. There is important geological evidence, primarily the presence of metamorphic and ancient sedimentary rock, to indicate that they may be an eastern outpost of a former land

area of continental proportions, or at least with continental connections, whose breaking up has left New Zealand and New Caledonia, as well as New Guinea and the Solomon Islands.

The evidence from the Fijian animal life affords considerable support to the hypothesis of continental origin. It is much richer in every group than that of the uniform small islands of Polynesia. Mammals, to be sure, are still absent, with the exception of the somewhat problematic rodent, Rattus exulans, which is said to inhabit various of the archipelagos of the Western Pacific, and of the several species of bats.

There are frogs of two kinds, the first to be encountered since leaving the mainland of South America. Snakes of four species, a blind-snake, two boas, and a poisonous elapid, afford equally striking evidence of a change in the nature of the fauna.

No less remarkable are the large iguanid lizards of the genus Brachylopus, which is allied to the land iguanas of the West Indies and the Galapagos. Another large lizard, an agamid, reaches the Fijis from New Britian. In addition to these novelties (from a Polynesian viewpoint) there is a whole series of species of lizards of the skink family which range widely through the islands eastward of New Guinea, reaching the Fiji Islands, but extending no further.

This variety of amphibians and reptiles gives a plainly continental aspect to the Fijian fauna, especially by contrast with the Polynesian poverty, and some other groups of land animals, especially the mollusks and the insects, are similarly developed. The absence of mammals may be interpreted here as in New Zealand, as an indication of separation at an extremely early date. The iguanid lizard suggests an age about equivalent to that of the separation of the West Indies from the Americas and of Madagascar from Africa, since both these areas support related forms. Brachylophus need not be derived from the Americas, since the Madagascan iguanid lizards as well as fossils from the Eocene of Europe, prove that this family formerly had a wide range in the Old World, where it is now extinct except for the relicts in Madagascar and the Fijis.

The insolubility of such a problem of continental connection without geological date is evident when the considerations contrary to the hypothesis of continental derivation of the fauna are examined. In New Zealand, the single genus of frogs (Liopelma) is a representative of the family Ascaphidae, otherwise known only from western North America. These are unmistakably the most primitive of all the frogs, and so bear out excellently the hypothesis of a land connection of New Zealand too ancient to have brought mammals with it.

The Fijian frogs, on the other hand, are representatives of the most modern family of frogs, the Ranidae (and are only slightly distinct from allied Solomon Island forms).

There are neither primitive mammals nor extraordinary flightless birds in the Fijis to link up the fauna with that of Australia or New Zealand. New Caledonia lacks not only mammals but frogs as well, and the same is true of the New Hebrides, much closer to continental Australia than the Fijis. Extinction must be supposed to have played a large part in the impoverishment of all these insular faunas if their continental origin is to be maintained.

The continental origin of these west Pacific Islands is on a wholly different footing than the various suppositions of connection of New Zealand and Australia with South America, or with Antarctica, and even a wholly inadequate proof of the land connection from Asia to the Fiji Islands would not contribute evidence in favor of such trans-Pacific land bridges. (From "The Fiji Times and Herald", September 13, 1931)

"UNCLE SAM'S REINDEER" BIG HELP TO ALASKANS

How reindeer represented actual physical salvation to the native Alaskans was told in a radio talk given in Washington by Dr. W.B. Bell of the Bureau of Biological Survey, U. S. Department of Agriculture. The talk was arranged by Science Service and sent out over the network of the Columbia Broadcasting System.

To Sheldon Jackson, early missionary to the people of Alaska, Dr. Bell gave the credit for the inspired vision and the practical sense to foresee and to provide for the needs of these poeple.

The Alaskans had lived a precarious and often pitiable existence as hunters, depending for food and clothing upon the wild animals they could take. The game supply was dwindling, and the migrations of the native carabou were never certain. All this made the securing of an always meager food supply ever more and more difficult.Frequently whole villages of men, women, and children had to face privation, and many perished miserably from slow starvation or disease induced by the lack of food. Conditions were steadily growing worse.Then the white men invaded the land and with their improved weapons, they further depleted the available game supply.

Dr. Bell said, "Sheldon Jackson saw and understood.Combining Christian charity with practical sense, he foresaw that the only hope for the deprived and destitute people of Alaska was a more dependable source of food and clothing.

"He thought of the reindeer. People of northern Norway,Sweden,Finland,Russia, Siberia and other arctic and subarctic lands had long been raising these animals, in a state of semi-domestication, and had found them a source of physical salvation. The caribou had found suitable food in the native forage of Alaska, and Jackson reasoned correctly that the closely related reindeer would also thrive there if introduced and properly cared for.

"It required prophetic vision for him to conceive this plan of bringing reindeer across from Siberia in order to transform the native people of Alaska from huntsmen to animal husbandmen. . . . As a result of all this earnest work, he realized his vision. Ten animals were brought over from eastern Siberia in 1891; in 1892, 171 more. By 1902 a total of 1,280 reindeer had been successfully landed on Alaskan shores.

"Then came the task of training the native people of Alaska to care for the reindeer properly and to utilize the animals in providing themselves with food and clothing. Patiently and persistently, Jackson and those he had interested had to train the people away from their precarious reliance upon wild game. For teachers they got some men to come over from Lapland.

"The reindeer found the lush browse and other vegetation of Alaska well suited to their needs. They multiplied by thousands and soon were providing meat for food and skins for clothing and to a limited extent were replacing husky dogs in drawing sledges.

"But as time passed and the animals increased in numbers,the crude, often inhumane methods and practices introduced by the Lapland herders began to show serious defects. The animals were slowly but surely deteriorating in character and decreasing in size.Certain of the grazing ranges were overstocked, and their productive capacity was seriously depleted.

"Under authorization of Congress,the Bureau of Biological Survey of the United States Department of Agriculture began investigational work in 1920. It has made steady progress since that time, in cooperation

with the Alaska College of Agriculture and School of Mines. Laws and regulations relating to reindeer management are administered by the Governor of the Territory of Alaska, acting through the United States Department of the Interior. The Biological Survey, working in cooperation with the College of Agriculture and School of Mines of Alaska, is responsible, under acts of Congress, for conducting research as to the grazing resources of the Territory, methods of feeding, and such reindeer management as will maintain the forage production on a sustained yield basis."

POI MAKING TODAY

The singing, chanting Hawaiian poi makers are fast passing. Poi is made today to the accompaniment of whirling machinery and the shouts of businesslike Chinese.

The growing of taro commercially, once entirely in the hands of Hawaiians, has also passed into those of other races.

Nor is this all. Charles Liu, Chinese-Hawaiian poi inspector of the city and county of Honolulu, believes that the Hawaiians are eating less poi these days, while other races are eating more and more of it.

The poi has its beginning in fields of green taro largely concentrated on the windward side of the island. Dry land taro is grown on the island of Hawaii, but all on this island is wet land taro. In most places on the windward side, it matures in 14 to 18 months. In Manoa Valley, where some is grown, it takes 18 to 22 months to mature.

Approximately 600 acres on this island are devoted to the crop commercially, of which nearly 80 per cent is cultivated by Chinese and 15 per cent by Japanese, Mr. Liu estimates.

Wong Hin, owner of the Oahu Poi factory, is the largest grower, with about 220 acres, followed by See Wo Co., with 110 acres and the Honolulu Poi factory with 65 acres.

"Wong Hin plants four varieties of taro: piialii, pikokea, pike, hapuupuu; and is experimenting with a fifth, makaopio," says Mr. Liu. "See Wo Co. plants piialii, piko, and pikokea. Other varieties grown commercially are known as ipuolono, kaolea, kaieleele, lauloa, haakea, apuwai, palai'e and lehua. In all, there were more than 150 varieties cultivated by the Hawaiians.

"The red poi manufactured by the different factories is made from the piialii taro and not from the lehua, as often thought. It is most in demand at present.

"The lehua taro is very rare because it is hard to raise locally, although a short time ago the Waimea poi mill received several shipments of it from Kauai. It was the first I had seen since I became poi inspector."

Taro must be carefully cultivated, because the difference in poi is often due not so much to the manufacture as to the quality of the root. Taro, like butter, will take on contaminating odors, and it is said that taro grown in an old fish or duck pond will taste of fish or ducks.

After the soil has been prepared, it is watered well and allowed to stand for two days. Then it is made into mounds six to eight inches high and the shoots planted on each little elevation, much as sweet potatoes are planted. The mounds are kept moist at the bottom, and often the entire field is flooded, the water covering the mounds and a part of the bottom of the stem.

The plants sometimes reach a height of two feet, but as the vegetable matures, the plant shrinks, with the root taking the vitality from the stem and leaves.

Practically the entire income from the taro fields is in the root of the plant, although the young leaves are sometimes sold as luau. The stem is known by the Hawaiians as haha and is cooked by them with salt salmon, but it enjoys a limited sale commercially.

From the fields, the taro goes nowadays to a poi factory, instead of to the polished koa poi board and stone pounder that was the pride of the ancient Hawaiian home. At the factory, it is steamed in a boiler, which has a capacity of 60 sacks of taro roots or more. It is then rinsed off with cold water, cleaned, scraped and pared. Next it is ground in a grinder especially manufactured on the mainland for the poi factories of Hawaii. It comes from the grinder to a poi mixing board where it is churned up with a little water.

Nine poi factories are in operation in Honolulu, six by Chinese, one by a Korean, one by a Japanese, and one by a Chinese-Hawaiian. The country districts have four poi factories.

The making of poi is regulated by law, and sanitation is enforced through the regular visits of the poi inspector. The rules provide that the taro must be thoroughly cooked, properly peeled and cleaned, and ground to the finest grain. The grinder machinery must be taken apart, washed and dried after each day's grinding. Blades are examined monthly, because it has been found that 40 per cent of the lumpy poi is caused by improper blades. All other implements must be cleaned before and after using. Two poi samples are collected monthly from each city factory, and once every three months from the country factories, and taken to the office of the food commissioner for residue and solidity analysis. Dealers of poi and restaurants serving poi are also inspected at intervals.

This is more of a task than might be suspected, because in the city there are 127 places where you may buy poi to take home, and 77 cafes and restaurants where you may order it served. In addition, two Honolulu hotels serve poi each day. The rural districts report 16 dealers, one cafe and one restaurant handling the Hawaiian staff of life.

Mr. Liu's report for the six months ending June 30 showed the rural district factories manufacturing 92,175 pounds of poi and the city factories a total of 3,017,283 pounds, against 3,113,109 pounds manufactured during the same months of 1931. The decrease in consumption since last year is due to depression, Mr. Liu says.

"Rice is cheaper than poi, and so people living on a small budget have turned from poi to rice," he explains. "The prevailing price of taro since last April was $1.25 to $1.40 per bag. Retail prices of poi were from 30 to 40 pounds for $1.00 cash at the factory or dealer, with the choicest quality selling 25 to 30 pounds for $1.00."

Mr. Liu foresees a slump in the price of poi and taro this fall, due to heavy plantings of taro, and he believes that this will send the demand upward again. The turn came during August, when 563,000 pounds of poi was consumed against 538,000 during August a year ago. Although he estimates that 70 per cent of the poi consumed at present is used by Hawaiians, he thinks that it is growing in popularity with other races.

Once a taste for poi is cultivated, it is never lost. Poi is an excellent food when used in proper relation with other foods, dieticians at the University of Hawaii have found. They attribute the splendid physique of the old-time Hawaiian to his well balanced diet of poi, fish and limu. (From "Honolulu Star-Bulletin", September 3, 1932)

INDUSTRIAL USE OF HAWAIIAN LIMU IS CONCEIVABLE

By
Leslie.S. Nakashima

The Hawaiian seaweed, or limu, utilized properly, might be a god-send to leaders of the Junior Republic,with its recreational and character building activity program for youths between 16 and 25. It could be the basis of a new local industry, the manufacture of gelatin and glue.And who can be better fitted than the youths to gather the various algae from the sea?

As early as 1906, Minnie Reed, M.S., a science teacher then at the Kamehameha manual training school for boys,suggested starting this industry, by utilizing the tons of edible seaweed available in making gelatin or glue. Both products are being imported by the United States from Japan and other countries. She also told of making farina, such as is produced along the coast of New England.

No capital or training would be necessary in collecting seaweed.All that would be required, she pointed out, was a cheap mill to grind the limu. The process is said to be simple. The gelatin or glue can be extracted from the limu by boiling it,after it has been washed and cleaned. The boiling period depends on the variety of seaweed. Limu manauea gives the best glue, a substance that is quite sticky but dries hard.

Why shouldn't the gelatin and glue, imported by Hawaii for household, commercial and school use, be produced here? If scientific methods are used, why shouldn't the industry be as profitable as it is in Japan? If the seaweed is the source of an annual income of $2,000,000 for Japan, certainly something could be done in Hawaii with a coastline of approximately 1,000 miles and an abundance of edible limu. Japanese wholesalers here import annually $35,000 worth of dried seaweed from Japan. Varieties include the kombu, wakame, and nori, for table use in Japanese homes.Chinese storekeepers also import from China their favorite edible algae.

Tons and tons of edible limu are going to waste on Hawaiian shores. Several hundred species have been collected in adjacent waters, 75 of them being used as food by Polynesians for ages. For each of them, the old-time Hawaiians had a name.With poi and fish their only other foods ancient Hawaiians naturally made extensive use of marine products and prized the limu highly. Some varieties of limu did not grow on all islands of the group. Historical accounts say that chiefs transplanted their favorite limu from one island to another. The limu pakaeleawaa, for example, was taken by a chief from Hawaii to Oahu and thence to Molokai.

Limu is said to be rich in phosphates, chlorides, bromides and iodides, important mineral matters for the human body. It practically served the place of vegetables to the Hawaiians until the haoles came. Limu Luau, best of all edible algae in Hawaiian waters, is found only along the high surf pounded rocks of northern Kauai, northern Maui and northern Hawaii,except for a few scattered places on Molokai and Oahu.

At the fish market, on the waikiki side of Kekaulike Street are 3 stalls, maintained by Hawaiian women,with limu, devilfish, shrimps and other marine products for sale. Nowadays, the collecting of limu has been facilitated with the use of knives, a long probing rod and glass bottomed boxes.The oldtime Hawaiian had to use an old stone chisel and resort to unaided vision.

Not all limu can be eaten, however, according to Mrs. Choy. One species is known as "limu make", a poisonous algae. The picked limu must be washed in fresh or salt water. Hawaiian women are careful to remove all grit or inedible limu. It is eaten raw as a Caucasian would

eat a relish. Limu can be preserved a few days or a week by salting, tying it closely in layers of ti leaves and placing in a shady place. Pounded seaweed is stored in calabashes or glass jars.

Some sort of crude cultivation of limu kohu was practiced by Hawaiians at Moloaa, Kauai, where it grows luxuriantly over the coral reef. As early as 1902, shipments in pounded balls were being made to the Honolulu market. The limu kohu there is said to be the best in color and flavor in the territory.

Although the commercialized seaweed industry of Japan has been so widely described, only 35 species there are reported to be used for food as compared to 75 in Hawaii. The National Geographic Society in a recent news bulletin announced that Japan last year harvested 450,000-000 pounds of seaweed, particularly the kombu, which grows in long strips in the deep waters off Hokkaido. The United States imports about 5,000 tons annually. More than a billion pounds of seaweed are harvested annually. Its early use was as fertilizer by the farmers near the sea. Today, besides serving as fertilizer and food, it is an ingredient of fine paper, knife handles and oriental curios. Australians have discovered a species from which cloth, rope, twine and mats can be made, according to this bulletin.

Ancient Hawaiians used limu in incantations to drive away sickness. It was said also to be an effective love potion. The lovelorn would eat a certain species, then give some to the person whose love was desired. It never failed to work, it is said, when that person partook of the limu. (From "Honolulu Star-Bulletin," December 26, 1931)

HAWAII'S CLIMATE IDEAL FOR PERFUME PLANTS

By
Theodore C. Zschokke
Extension Forester, University of Hawaii--
A radio talk over KGU, Honolulu "Advertiser," March 11, 1932

There are a number of plants in the Hawaiian Islands which have sweet scented leaves or flowers and in other parts of the world some of these are grown for their perfume. Soil and climatic conditions here are valuable for their growth and it ought to be possible to use more of them for perfume than is the case at present.

Probably the best known plant and one highly esteemed for its scented leaves, is the maile. This is a vine growing in the forests. The bark, with the leaves attached, is stringed off the stems and is twined with flowers into leis or garlands. The wilting leaves are more strongly scented than when fresh, which is a most desirable feature in a lei. The maile from Hawaii is preferred to that from the other islands because of the stronger perfume in the leaves and certain lei makers in Honolulu use it and no other. The Hawaiians used maile for decorating their homes during festivals and they placed the leaves between folds of kapa before packing them away in calabashes.

The ancient Hawaiians had another plant which they used to perfume their kapa and especially their feather capes. It is the enaena, a woody plant with white woolly stems belonging to the genus gnaphalium. Several species of this plant are found on the Mainland and all have an aromatic odor.

The mokihana is a small tree found on the island of Kauai. It is famous in Hawaiian songs and legends because of the distinctive anise odor of its twigs and more especially of its capsules. The capsules keep their odor indefinitely and they are therefore strung into leis. Unfortunately the capsules produce a rash on some people, nevertheless all kamaainas are delighted to receive mokihana leis from their friends on Kauai.

The native ginger or awapuhi has aromatic underground stems which were pulverized and dried by the ancient Hawaiians. This powder was sprinkled over the kapa before being folded and placed in calabashes.

At times the awapuhi stems are spread on the ground at open air festivals in order that the trampled stems may perfume the air. The awapuhi buds contain a clear liquid which is used to this day as a shampoo. The leaves are used for wrapping meat before placing it in the cooking pits. The leaves flavor the meat and also keep the ashes off the food. Both the yellow and the white flowered gingers are of early introduction and are among the most popular flowers for leis, both because of their color and daintiness of form, and also because of their sweet perfume.

The plumeria probably is more widely used for leis than any other flower because of its many advantages. It is slow to wilt, it has a sweet scent, and has a pleasing form and color. Besides the usual white blossoms with yellow centers, there are pure white, yellow and red species as well as many hybrids of these, producing a great variety of beautifully colored flowers.

There are many other sweet scented flowers which are used in leis which in other countries are used for perfume and which could be used here more than they are for making perfume. These include mulang, a beautiful lawn tree, the papaya, especially the pollen bearing flowers, the jasmine, the cestrums, stephanotis, coffee, carissa, orange, and others, including the lang-lang.

The lang-lang is a woody vine with inconspicuous greenish, sweet scented flowers. This vine should not be confused with the Philippine tree called ilang-ilang. This tree is growing in many sugar plantation camps and should be more extensively planted. It is a fast growing tree and if it is raised for its flowers it should be topped, otherwise it will make a tall shade tree. The flowers of the ilang-ilang resemble those of the lang-lang but the petals are longer, more narrow, and of a deeper yellow and the perfume is much superior to that of the lang-lang. The oil of the ilang-ilang flowers is used as the base of most modern perfumes and there is no reason why the trees cannot be grown in sheltered places along our highways to give an added attraction to our countryside.

One of the earliest of the introduced plants was the klu brought in by Don Marin. The klu or aroma or cassie, as it is variously called, is a thorny shrub growing in dry regions. It has masses of globular, yellow flowers which have a very sweet odor and it deserves a place either as a shrub or as a hedge in gardens on the leeward side of the islands where rainfall is scanty. With a little attention it will become a profusely blooming shrub. The klu is the source of cassie perfume in France and Italy and was brought to Hawaii with the expectation that the people would make their own perfume. The shrub exudes a gum which is said to be better than gum arabic and its pods can be used for tanning.

There is a grass which is extensively grown in India for the sweet scented citronella oil which is made from its leaves. This oil is used to perfume soaps, three-in-one oil, and is rubbed on the hands and face to keep away mosquitoes. It has many other uses. This lemon scented grass grows readily here and it should be planted more widely. It could be spread on the ground at open air gatherings because the odor of the trampled leaves will help keep mosquitoes away and a few leaves thrown on hot ashes will make a more effective smudge than ordinary smoke.

Further information about the perfume plants of the Hawaiian Islands may be obtained by writing to the Agricultural Extension Service, University of Hawaii.